

Federal Aviation Administration – [Regulations and Policies](#)
Aviation Rulemaking Advisory Committee

Transport Airplane and Engine Issue Area
Loads and Dynamics Harmonization Working Group
Task 4 – Interaction of Systems and Structure

Task Assignment

Aviation Rulemaking Advisory Committee; Transport Airplane and Engine Issues

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of establishment of the Braking Systems Harmonization Working Group.

SUMMARY: Notice is given of the establishment of the Braking Systems Harmonization Working Group by the Aviation Rulemaking Advisory Committee (ARAC). This notice informs the public of the activities of the ARAC.

FOR FURTHER INFORMATION CONTACT: Michael H. Borfitt, Assistant Executive Director, Aviation Rulemaking Advisory Committee, Transport Airplane and Engine Issues, FAA Engine & Propeller Directorate, 12 New England Executive Park, Burlington, Massachusetts 01803; telephone (617) 238-7110, fax (617) 238-7199.

SUPPLEMENTARY INFORMATION: On January 22, 1991 (56 FR 2190), the Federal Aviation Administration (FAA) established the Aviation Rulemaking Advisory Committee (ARAC). The committee provides advice and recommendations to the FAA Administrator, through the Associate Administrator for Regulation and Certification, on the full range of the FAA's rulemaking activities with respect to aviation-related issues.

In order to develop such advice and recommendations, the ARAC may choose to establish working groups to which specific tasks are assigned. Such working groups are comprised of experts from those organizations having an interest in the assigned tasks. A working group member need not be a representative of the full committee. Recently the ARAC established the Braking Systems Harmonization Working Group.

The FAA announced at the Joint Aviation Authorities (JAA)-Federal Aviation Administration (FAA) Harmonization Conference in Toronto, Canada June 2-5, 1992 that it would consolidate within the ARAC structure an ongoing objective to "harmonize" the Joint Aviation Requirements (JAR) and the Federal Aviation Regulations (FAR).

Tasks

The Braking Systems Harmonization Working Group is charged with recommending to the ARAC new or revised requirements for approval of brakes installed on transport category airplanes. The product of this exercise is intended to be a harmonized standard, acceptable to both the FAA

and the Joint Aviation Authorities (JAA).

Reports

The Braking Systems Harmonization Working Group should develop and present to the ARAC:

1. A recommended work plan for completion of the task, including the rationale supporting such plan, for consideration at the meeting of the ARAC to consider transport airplane and engine issues held following publication of this notice;
2. A detailed conceptual presentation on the proposed recommendation(s), prior to proceeding with the work stated in item 3. below;
3. A draft Notice of Proposed Rulemaking (NPRM), with supporting economic and other required analyses, and/or any other related guidance material or collateral documents the working group determines to be appropriate; or, if new or revised requirements or compliance methods are not recommended, a draft report stating the rationale for not making such recommendations; and
4. A status report at each meeting of the ARAC held to consider transport airplane and engine issues.

Participation in Working Group Task

An individual who has expertise in the subject matter and wishes to become a member of the working group should write to the person listed under the caption **FOR FURTHER INFORMATION CONTACT** expressing that desire, describing his or her interest in the task and stating the expertise he or she would bring to the working group. The request will be reviewed with the assistant chairman and working group leader, and the individual will be advised whether or not the request can be accommodated.

The Secretary of Transportation has determined that the information and use of the Aviation Rulemaking Advisory Committee are necessary in the public interest in connection with the performance of duties imposed on the FAA by law. Meetings of the Aviation Rulemaking Advisory Committee will be open to the public, except as authorized by section 10(d) of the Federal Advisory Committee Act. Meetings of the working group will not be open to the public, except to the extent that individuals with an interest and expertise are selected to participate. No public announcement of working group meetings will be made.

Issued in Washington, DC, on June 3, 1994.

Chris A. Christie,
Executive Director, Aviation Rulemaking Advisory Committee.

[FR Doc. 94-14146 Filed 6-9-94; 8:45 am]

BILLING CODE 4910-13-M

Recommendation Letter

Pratt & Whitney
100 Main Street
Hartford, CT 06108



Pratt & Whitney
A United Technologies Company

December 20, 1999

Department of Transportation
Federal Aviation Administration
800 Independence Ave, SW
Washington, D.C. 20591

Attention: Mr. Tom McSweeney, Associate Administrator for Regulation and Certification

Reference: ARAC Tasking, Federal Register, November 26, 1999

Dear Tom,

In accordance with the reference tasking statement, the ARAC Transport Airplane and Engine Issues Group is pleased to forward the attached technical report (in NPRM/AC format) which provides ARAC's recommendation for FAR/JAR harmonization of 25.361/25.362, Engine and Auxiliary Power Unit Load Conditions. This report has been prepared by the ~~Joint Industry/FAA Harmonization Working Group~~ of the TAEIG.

Sincerely,

C. R. Bolt
Assistant Chair, TAEIG
Phone: 860-565-9348, Fax 860-557-2277, M/S 162-24
Email: boltcr@pweh.com

cc: Dorenda Baker – FAA-NWR*
Tony Fazio – FAA. ARM-1*
Kristin Larson – FAA-NWR
Larry Hanson, Gulfstream*
*letter only

Acknowledgement Letter

MAR 15 2000 *

Mr. Craig Bolt
Assistant Chair, Transport Airplanes
and Engines Issues Group
400 Main Street
East Hartford, CT 06108

Dear Mr. Bolt:

This letter acknowledges receipt of the following working group technical reports that you have submitted on behalf of the Aviation Rulemaking Advisory Committee (ARAC) on Transport Airplane and Engine Issues (TAE):

Date of Letter	Task No.	Description of Recommendation	Working Group
12/14/00	1, 2, 3	Fast track reports addressing §§ 25.703(a) thru (c) (takeoff warning system); 25.1333(b) (instrument systems; and 25.1423(b) (public address system)	ASHWG ✓
12/17/00	5	Fast track reports addressing §§ 25.111(c)(4), 25.147, controllability in 1-engine inoperative condition; 25.161 (c) (2) and (4), and (e) (longitudinal trim and airplanes with 4 or more engines) 25.175(d) (static longitudinal stability; 25.177(a)(b) (static lateral-directional stability); 25.253(a)(3) (high speed characteristics); 25.1323(c) (airspeed indicating system); 25.1516 (landing gear speeds); 25.1527 (maximum operating altitude); 25.1583(c) and (f) operating limitations) 25.1585 (operating procedures); and 25.1587 (performance information)	FTHWG ✓
12/17/00	7	Fast track report addressing § 25.903(e) (inflight engine failures)	PPIHWG ✓

12/20/00	5	Fast track reports addressing §§ 25.1103 (auxiliary power units); 25.933(a) (thrust reversers); 25.1189 (shutoff means); 25.1141 (powerplant controls); 25.1093 (air intake/induction systems); 25.1091 (air intake system icing protection); 25.943 (thrust reverser system tests); 25.934 (negative acceleration); 25.905(d) (propeller blade debris); 25.903(d)(1) (engine case burn-through); 25.901(d) (auxiliary power unit installation; and 1.1 (general definitions)	✓ PPIHWG
12/20/00	4	Fast track report, category 2 format--NRRM addressing § 25.302 and appendix K (interaction of systems and structures	✓ LDHWG
12/20/00	2	Fast track report—(in NPRM/AC format) addressing §§ 25.361 and 25.362 (engine and auxiliary power unit load conditions)	✓ LDHWG
12/20/00	1	Fast track report addressing § 25.1438 (pressurization and low pressure pneumatic systems)	✓ MSHWG

The above listed reports will be forwarded to the Transport Airplane Directorate for review. The Federal Aviation Administration's (FAA) progress will be reported at the TAE meetings.

This letter also acknowledges receipt of your July 28, 1999, submittal which included proposed notices and advisory material addressing lightning protection. We apologize for the delay. Although the lightning protection task is not covered under the fast track proposal, the FAA recognizes that technical agreement has been reached and we will process the package accordingly. The package has been sent to Aircraft Certification for review; the working group will be kept informed of its progress through the FAA representative assigned to the group.

Lastly, at the December 8 - 9, 1999, TAE meeting, Mr. Phil Salee of the Powerplant Installation Harmonization Working Group indicated that the working group members agreed that § 25.1103 was sufficiently harmonized and that any further action was beyond the scope of task 8 assigned. We agreed with the TAE membership to close the task. This letter confirms the FAA's action to close the task to harmonize § 25.1103.

Recommendation

[4910-13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. ; Notice No.]

RIN: 2120-

Interaction of Systems and Structures

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of proposed rulemaking.

SUMMARY: This notice proposes to revise the design standards for transport category airplanes equipped with systems that directly or as a result of a failure or malfunction would affect the structural performance of the airplane. This action would incorporate into the regulations the latest criteria developed for special conditions used in the certification of airplanes equipped with fly-by-wire and active flight control systems. This action would also relieve a burden on industry by eliminating differences between the Federal Aviation Regulations (FAR) and European Joint Airworthiness Regulations (JAR).

DATES: Comments must be received on or before [insert date 90 days after date of publication in the Federal Register].

ADDRESS: Comments on this proposal may be mailed in triplicate to: Federal Aviation Administration, Office of the Chief Counsel, Attention: Rules Docket (AGC-10), Docket No. , 800 Independence Avenue SW., Washington DC 20591; or delivered in triplicate to: Room 915G, 800 Independence Avenue SW., Washington, DC 20591. Comments delivered must be marked: Docket No. . Comments may also be submitted electronically to nprmcmts@mail.hq.faa.gov. Comments may be examined in room 915G weekdays, except Federal holidays, between 8:30 a.m. and 5:00 p.m. In addition, the FAA is maintaining an information docket of comments in the Transport Airplane Directorate (ANM-100), FAA, 1601 Lind Avenue SW., Renton, WA 98055-4056. Comments in the information docket may be examined weekdays, except Federal holidays, between 7:30 a.m. and 4:00 p.m.

FOR FURTHER INFORMATION CONTACT: James Haynes, FAA Airframe and Propulsion Branch (ANM-112), Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, WA 98055-4056; telephone (206) 227-2131.

SUPPLEMENTARY INFORMATION:

Comments Invited

Interested persons are invited to participate in the proposed rulemaking by submitting such written data, views, or arguments as they may desire. Comments relating to the environmental, energy or economic impact that might result from adoption of proposals contained in this notice are invited. Substantive comments should be accompanied by cost estimates. Commenters should identify the regulatory docket or notice number and submit comments in triplicate to the Rules Docket addressed specified above. All comments will be considered by the Administrator before taking action on the proposed rulemaking. The proposals contained in this notice may be changed in light of comments received. All comments will be available in the Rules Docket, both before and after the closing date for comments, for examination by interested persons. A report summarizing each substantive public contact with FAA personnel concerning this rulemaking will be filed in the docket. Commenters wishing the FAA to acknowledge receipt of their comments must submit with those comments a self-addressed, stamped postcard on which the following statement is made: "Comments to Docket No. . ." The postcard will be date/time stamped and returned to the commenter.

Availability of the NPRM

An electronic copy of this document may be downloaded using a modem and suitable communications software from the FAA regulations section of the Fedworld electronic bulletin board service (telephone: 703-321-3339), the Federal Register's electronic bulletin board service (telephone: 202-512-1661), or the FAA's Aviation Rulemaking Advisory Committee Bulletin Board service (telephone: 202-267-5984).

Internet users may reach the FAA's web page at <http://www.faa.gov> or the Federal Register's web page at http://www.access.gpo/su_docs for access to recently published rulemaking documents.

Any person may obtain a copy of this NPRM by submitting a request to the Federal Aviation Administration, Office of Rulemaking, ARM-1, 800 Independence Avenue SW., Washington, D.C. 20591, or by calling (202) 267-9680. Communications must identify the notice number of this NPRM. Persons interested in being placed on a mailing list for future rulemaking documents should also request a copy of Advisory Circular No. 11-2A, Notice of Proposed Rulemaking Distribution System, which describes the application procedures.

Background

Active flight control systems are capable of providing automatic responses to external inputs from sources other than the pilots. Active flight control systems have been expanded in function, effectiveness, and reliability to the point that fly-by-wire flight controls, without a manual backup system in the event of system failures, are becoming standard equipment on larger transport airplanes. As a result of these advancements in flight controls technology, the current safety standards contained in 14 CFR part 25 do not provide an adequate basis to address an acceptable level of safety for airplanes equipped with these advanced systems. Instead, certification of these systems has been achieved by issuance of special conditions under the provisions of 14 CFR section 21.16.

For example, stability augmentation systems (SAS), and to a lesser extent load alleviation systems (LAS), have been used on transport airplanes for many years. Past approvals of these systems were based on individual findings of equivalent level of safety with existing rules and on special conditions. An advisory circular (AC 25.672-1) was issued November 11, 1983 that provided an equivalent means of compliance under the provisions of § 21.21(b)(1) for SAS, LAS, flutter control systems (FCS), another type of active control system.

Although autopilots are also considered active control systems, typically their control authority has been limited such that the consequences of system failures could be readily counteracted by the pilot. Now, autopilot functions are integrated into the primary flight controls and are given sufficient control authority to maneuver the airplane to its structural design limits. This advanced technology with its expanded authority requires a new approach to account for the interaction of control systems and structures.

The usual deterministic approach to defining the loads envelope contained in part 25 does not fully account for system effectiveness and system reliability. These automatic systems may be inoperative or may operate in a degraded mode with less than full system authority. Therefore, it is necessary to determine the structural factors of safety and operating margins such that the joint probability of structural failures due to application of loads during system malfunctions is not greater than that found in airplanes equipped with earlier technology control systems. To achieve this objective it is necessary to define the failure conditions with their associated frequency of occurrence in order to determine the structural factors of safety and operating margins that will ensure an acceptable level of safety.

Earlier automatic control systems usually provided two states, either fully functioning or a total loss of function. These conditions were readily detected by the flightcrew. The new active flight control systems have failure modes that allow the system to function in the degraded mode without full authority. This degraded mode is not readily detectable by the flightcrew. Therefore, monitoring systems are required on these new systems to provide an annunciation of a condition of degraded system capability.

In 1988, the FAA, in cooperation with the JAA and organizations representing the U.S. and European aerospace industries, began a process to harmonize the airworthiness requirements of the United States and the airworthiness requirements of the European authorities. The objective was to achieve common requirements for the certification of transport airplanes without a substantive change in the level of safety. Other airworthiness authorities such as Transport Canada also participated in this process.

In 1992, the harmonization effort was undertaken by the Aviation Regulatory Advisory Committee (ARAC). By notice in the Federal Register (58 FR 13819, March 15, 1993), the FAA chartered a working group of industry and government structural specialists of Europe, the U.S., and Canada. The harmonization effort has now progressed to the point that some specific proposals have been developed by the working group for the interaction of systems and structures requirements of part 25. These proposals have been adopted by ARAC and recommended to the FAA by letter dated [insert date submitted to the FAA]. This notice

Revised 21 Sept 99 Par (e) Dispatch with Failure Revised 9 Sept 1999per Jim Haynes Draft NPRM 24 June 1999
contains the proposals necessary to achieve harmonization of the interaction of systems and structures requirements of part 25.

In this proposed revision, and in the current standards and regulations, the term "any" is used. Use of this term has traditionally been understood to require the applicant to address all items covered by the term, rather than addressing only a portion of the items. The use of the term "any" in this amendment continues this traditional understanding.

Discussion

This notice proposes to incorporate the safety requirements found necessary for airplanes equipped with active flight controls and fly-by-wire flight control systems except that the general philosophy of accounting for the impact of system failures on structural performance would be extended to include any system whose partial or complete failure, alone or in combination with other system partial or complete failures, would affect structural performance. The required structural factors of safety would be defined as a function of system reliability. This is an extension of the current philosophy that the airplane should be capable of continued safe flight and landing after specific failure events not shown to be extremely improbable.

Paragraph (e) of this proposal provides for the consideration of expected operational limits in the establishment of the appropriate safety factors. These limits are the expected maximum limits for dispatch in the failure condition and would be established consistent with experience on similar equipment in service.

In addition to providing requirements for static strength this notice proposes requirements that account for the effects of system failures on fatigue, damage tolerance, residual strength, deformation and aeroelastic stability. The impact of all combinations of system failures not shown to be extremely improbable need to be investigated.

This action should not have a significant economic impact on the manufacturers of new airplanes since it incorporates the criteria already applied by special conditions to new technology airplanes. Nor would it place a significant design burden on the applicant because there are many design options available including conventional control systems. This proposal would add a new

§ 25.302 and a new Appendix K to part 25 to incorporate these latest safety standards. It would also amend §§ 25.305 and 25.629 to make these rules compatible with the new § 25.302 rule.

Regulatory Evaluation Summary

Regulatory Evaluation Summary. Regulatory Flexibility Determination. and Trade Impact Assessment

Changes to federal regulations must undergo several economic analyses. First, Executive Order 12866 directs Federal agencies to promulgate new regulations or modify existing regulations only if the potential benefits to society outweigh the potential costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic impact of regulatory changes on small entities. Finally, the Office of Management and Budget directs agencies to assess the effects of regulatory changes on international trade. In conducting these assessments, the FAA has determined that this proposed rule: (1) would generate benefits exceeding its costs and is not "significant" as defined in Executive Order 12866; (2) is not "significant" as defined in DOT's Policies and Procedures; (3) would not have a significant impact on a substantial number of small entities; and (4) would lessen restraints on international trade. These analyses, available in the docket, are summarized below.

Regulatory Evaluation Summary

The proposed requirements would apply to future type certificated transport category airplanes and would not impose additional costs on manufacturers. The latest criteria developed for recent special conditions for fly-by-wire and active flight control systems would be incorporated into the FAR. The special conditions contain safety standards necessary to maintain a level of safety equivalent to that established in the FAR. Special conditions are never used as a means to increase the level of safety above that described by the certification basis of the airplane or product. Where special conditions are necessary in order to certify a product, it is not incumbent on the FAA to assess their cost-effectiveness. The cost-effectiveness of a novel or unique design is the responsibility of the applicant and is implicit in the applicant's design decision. Furthermore, it is unlikely that a unique design would become industry practice unless industry deemed it cost effective.

One manufacturer of part 25 small airplanes is concerned that, in order to prevent risk of new loads impacting a new type certification program in the test phase, it would have to make conservative assumptions on the Appendix K factors or extend the program to allow a design iteration which includes actual factors generated from known system failure probabilities. The FAA maintains that the current regulations already require system safety analyses that estimate system failure probabilities. The same manufacturer states that Appendix K would increase airplane weight. The FAA believes that compliance with Appendix K should result in a lighter airplane. The manufacturer also contends that it and other manufacturers currently provide the intent of proposed § 25.302 through compliance with the existing FAR. The FAA disagrees with this interpretation. Under the current regulations, in order to take advantage of any loads relief provided by any active control system, it is necessary to comply with either special conditions or findings of equivalent safety. In either case, compliance with standards equivalent to Appendix K would be required. There are no current part 25 regulations that provide the intent of § 25.302 unless supplemented with equivalent safety standards.

Another manufacturer of part 25 small airplanes indicates that the requirements of proposed Appendix K seem to also pertain to older mechanical systems and therefore may impose additional costs. The FAA notes that the proposed Appendix K requirements pertaining to such systems essentially reflect those of current §§ 25.671 (Control Systems, General) and 25.672 (Stability augmentation and automatic and power-operated systems), as well as those of §§ 25.1309 (Equipment, systems, and installations) and 25.1329 (Automatic pilot system). Consequently, no new costs would be imposed with respect to certification of mechanical systems.

Finally, by harmonizing the standards of the FAR and JAR, the proposed rule would yield cost savings by eliminating duplicate certification activities. One manufacturer of part 25 large airplanes estimates potential cost-savings of approximately \$80,000 per type certification. Increased efficiency from codification of the proposed requirements, as opposed to continued reliance on special conditions, would supplement these benefits.

Based on the finding of no incremental costs imposed, coupled with the cost savings realizable from harmonization, the FAA has determined that the proposed rule is cost-beneficial.

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily and disproportionately burdened by Government regulations. The RFA requires agencies to determine whether rules would have "a significant economic impact on a substantial number of small entities." FAA Order 2100.14A, Regulatory Flexibility Criteria and Guidance, prescribes standards for complying with RFA requirements in FAA rulemaking actions. The Order defines "small entities" in terms of size thresholds, "significant economic impact" in terms of annualized cost thresholds, and "substantial number" as a number which is not less than eleven and which is more than one-third of the affected small entities.

The proposed rule would affect manufacturers of transport category airplanes produced under future new airplane type certifications. For airplane manufacturers, FAA Order 2100.14A specifies a size threshold for classification as a small entity as 75 or fewer employees. Since no part 25 airplane manufacturer has 75 or fewer employees, the proposed rule would not have a significant economic impact on a substantial number of small airplane manufacturers.

International Trade Impact Assessment

The proposed rule would have no adverse impact on trade opportunities for U.S. manufacturers selling airplanes in foreign markets and foreign manufacturers selling airplanes in the U.S. market. Instead, by harmonizing the standards of the FAR and the JAR, it would lessen restraints on trade.

Federalism Implications

The regulations proposed herein would not have substantial direct effects on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government. Therefore, in accordance with Executive Order 12612, it is determined that this proposal would not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

International Compatibility

The FAA has reviewed corresponding International Civil Aviation Organization regulations and the regulations of the Joint Aviation Authorities, where they exist, and has identified no differences in these proposed amendments and the foreign regulations.

Paperwork Reduction Act

In accordance with the Paperwork Reduction Act of 1980 (Pub. L. 96-511), there are no requirements for information collection associated with this proposed rule.

Conclusion

Because the proposed changes to the loads requirements are not expected to result in substantial economic cost, the FAA has determined that this proposed rule would not be significant under Executive Order 12866. Because this is an issue that has not prompted a great deal of public concern, the FAA has determined that this action is not significant as defined in Department of Transportation Regulatory Policies and Procedures (44 FR 11034, February 25, 1979). In addition, since there are no small entities affected by this proposed rulemaking, the FAA certifies, under the criteria of the Regulatory Flexibility Act, that this proposed rule, if adopted, would not have a significant economic impact, positive or negative, on a substantial number of small entities. An initial regulatory evaluation of the proposed rule, including a Regulatory Flexibility determination and Trade Impact Analysis, has been placed in the docket. A copy may be obtained by contacting the person identified under the caption "FOR FURTHER INFORMATION CONTACT."

List of Subjects in 14 CFR part 25

Aircraft, Aviation safety, Reporting and Record keeping requirements.

The Proposed Amendments

Accordingly, the Federal Aviation Administration (FAA) proposes to amend 14 CFR part 25 of the Federal Aviation Regulations (FAR) as follows:

PART 25-AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES

1. The authority citation of Part 25 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

2. By adding a new paragraph § 25.302 to read as follows:

§ 25.302 Interaction of systems and structures.

For airplanes equipped with systems that affect structural performance, either directly or as a result of a failure or malfunction, the influence of these systems and their failure conditions must be taken into account when showing compliance with the requirements of Subparts C and D. Appendix K of this part must be used to evaluate the structural performance of airplanes equipped with these systems.

3. By adding a new Appendix K to read as follows:

APPENDIX K TO PART 25 - INTERACTION OF SYSTEMS AND STRUCTURES

K25.1 General.

The following criteria must be used for showing compliance with § 25.302 for airplanes equipped with flight control systems, autopilots, stability augmentation systems, load alleviation systems, flutter control systems, and fuel management systems. If this appendix is used for other systems, it may be necessary to adapt the criteria to the specific system.

(a) The criteria defined herein only address the direct structural consequences of the system responses and performances and cannot be considered in isolation but should be included in the overall safety evaluation of the airplane. These criteria may in some instances duplicate standards already established for this evaluation. These criteria are only applicable to structure whose failure could prevent continued safe flight and landing. Specific criteria that define acceptable limits on handling characteristics or stability requirements when operating in the system degraded or inoperative mode are not provided in this appendix.

(b) Depending upon the specific characteristics of the airplane, additional studies may be required that go beyond the criteria provided in this appendix in order to demonstrate the capability of the airplane to meet other realistic conditions such as alternative gust or maneuver descriptions for an airplane equipped with a load alleviation system.

(c) The following definitions are applicable to this appendix.

Structural performance: Capability of the airplane to meet the structural requirements of Part 25.

Flight limitations: Limitations that can be applied to the airplane flight conditions following an in-flight occurrence and that are included in the flight manual (e.g., speed limitations, avoidance of severe weather conditions, etc.).

Operational limitations: Limitations, including flight limitations, that can be applied to the airplane operating conditions before dispatch (e.g., fuel, payload and Master Minimum Equipment List limitations).

Probabilistic terms: The probabilistic terms (probable, improbable, extremely improbable) used in this appendix are the same as those used in § 25.1309.

Failure condition: The term failure condition is the same as that used in § 25.1309, however this appendix applies only to system failure conditions that affect the structural performance of the airplane (e.g., system failure conditions that induce loads, change the response of the airplane to inputs such as gusts or pilot actions, or lower flutter margins).

K25.2 Effects of Systems on Structures.

(a) General. The following criteria will be used in determining the influence of a system and its failure conditions on the airplane structure.

(b) System fully operative. With the system fully operative, the following apply:

(1) Limit loads must be derived in all normal operating configurations of the system from all the limit conditions specified in Subpart C, taking into account any special behavior of such a system or associated functions or any effect on the structural performance of the airplane that may occur up to the limit loads. In particular, any significant nonlinearity (rate of displacement of control surface, thresholds or any other system nonlinearities) must be accounted for in a realistic or conservative way when deriving limit loads from limit conditions.

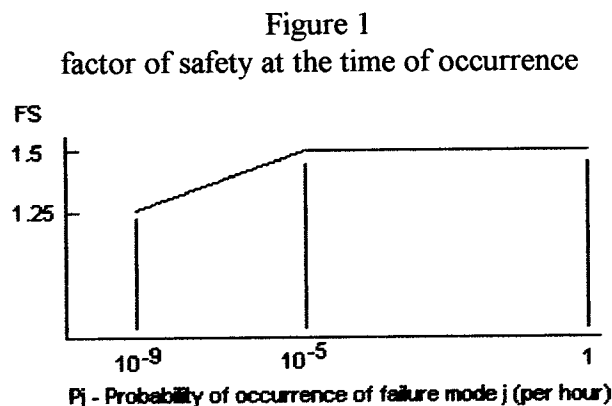
(2) The airplane must meet the strength requirements of part 25 (Static strength, residual strength), using the specified factors to derive ultimate loads from the limit loads defined above. The effect of nonlinearities must be investigated beyond limit conditions to ensure the behavior of the system presents no anomaly compared to the behavior below limit conditions. However, conditions beyond limit conditions need not be considered when it can be shown that the airplane has design features that will not allow it to exceed those limit conditions.

(3) The airplane must meet the aeroelastic stability requirements of § 25.629.

(c) System in the failure condition. For any system failure condition not shown to be extremely improbable, the following apply:

(1) At the time of occurrence. Starting from 1-g level flight conditions, a realistic scenario, including pilot corrective actions, must be established to determine the loads occurring at the time of failure and immediately after failure.

(i) For static strength substantiation, these loads multiplied by an appropriate factor of safety that is related to the probability of occurrence of the failure are ultimate loads to be considered for design. The factor of safety (F.S.) is defined in Figure 1.



(ii) For residual strength substantiation, the airplane must be able to withstand two thirds of the ultimate loads defined in subparagraph (c)(1)(i).

(iii) Freedom from aeroelastic instability must be shown up to the speeds defined in § 25.629(b)(2). For failure conditions that result in speed increases beyond V_C/M_C , freedom

from aeroelastic instability must be shown to increased speeds, so that the margins intended by § 25.629(b)(2) are maintained.

(iv) Failures of the system that result in forced structural vibrations (oscillatory failures) must not produce loads that could result in detrimental deformation of primary structure.

(2) For the continuation of the flight. For the airplane, in the system failed state and considering any appropriate reconfiguration and flight limitations, the following apply:

(i) The loads derived from the following conditions at speeds up to V_c , or the speed limitation prescribed for the remainder of the flight must be determined:

(A) the limit symmetrical maneuvering conditions specified in § 25.331 and in § 25.345.

(B) the limit gust and turbulence conditions specified in § 25.341 and in § 25.345.

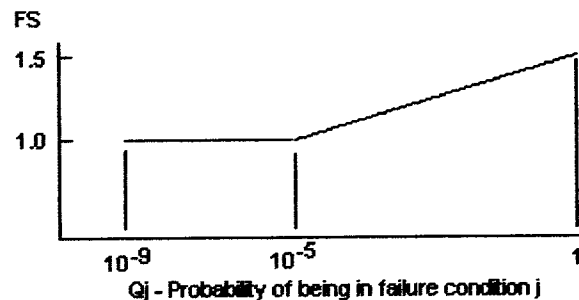
(C) the limit rolling conditions specified in § 25.349 and the limit unsymmetrical conditions specified in § 25.367 and § 25.427(b) and (c).

(D) the limit yaw maneuvering conditions specified in § 25.351.

(E) the limit ground loading conditions specified in § 25.473 and § 25.491.

(ii) For static strength substantiation, each part of the structure must be able to withstand the loads in subparagraph (2)(i) of this paragraph multiplied by a factor of safety depending on the probability of being in this failure state. The factor of safety is defined in Figure 2.

Figure 2
Factor of safety for continuation of flight



$Q_j = (T_j)(P_j)$ where:

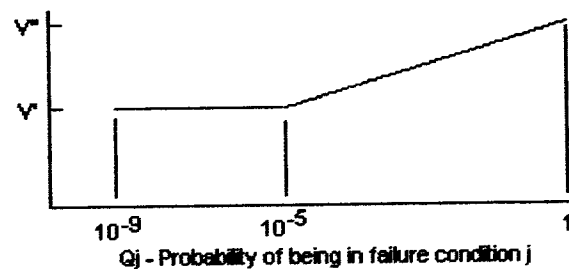
T_j = Average time spent in failure condition j (in hours)

P_j = Probability of occurrence of failure mode j (per hour)

Note: If P_j is greater than 10^{-3} , per flight hour then a 1.5 factor of safety must be applied to all limit load conditions specified in Subpart C.

- (iii) For residual strength substantiation, the airplane must be able to withstand two thirds of the ultimate loads defined in subparagraph (c) (2) (ii).
- (iv) If the loads induced by the failure condition have a significant effect on fatigue or damage tolerance then their effects must be taken into account.
- (v) Freedom from aeroelastic instability must be shown up to a speed determined from Figure 3. Flutter clearance speeds V' and V'' may be based on the speed limitation specified for the remainder of the flight using the margins defined by § 25.629(b).

Figure 3
Clearance speed



$V' =$ Clearance speed as defined by § 25.629(b)(2).

$V'' =$ Clearance speed as defined by § 25.629(b)(1).

$Q_j = (T_j)(P_j)$ where:

$T_j =$ Average time spent in failure condition j (in hours)

$P_j =$ Probability of occurrence of failure mode j (per hour)

Note: If P_j is greater than 10^{-3} per flight hour, then the flutter clearance speed must not be less than V'' .

(vi) Freedom from aeroelastic instability must also be shown up to V' in Figure 3 above, for any probable system failure condition combined with any damage required or selected for investigation by § 25.571(b).

(3) Consideration of certain failure conditions may be required by other Sections of this Part regardless of calculated system reliability. Where analysis shows the probability of these failure conditions to be less than 10^{-9} , criteria other than those specified in this paragraph may be used for structural substantiation to show continued safe flight and landing.

(d) Warning considerations. For system failure detection and warning, the following apply:

(1). The system must be checked for failure conditions, not extremely improbable, that degrade the structural capability below the level required by part 25 or significantly reduce the reliability of the remaining system. The flight crew must be made aware of these failures before flight. Certain elements of the control system, such as mechanical and hydraulic components, may use special periodic inspections, and electronic components may use daily checks, in lieu of warning systems to achieve the objective of this requirement. These certification maintenance requirements must be limited to components that are not readily detectable by normal warning systems and where service history shows that inspections will provide an adequate level of safety.

(2). The existence of any failure condition, not extremely improbable, during flight that could significantly affect the structural capability of the airplane and for which the associated reduction in airworthiness can be minimized by suitable flight limitations, must be signaled to the flightcrew. For example, failure conditions that result in a factor of safety between the airplane strength and the loads of Subpart C below 1.25, or flutter margins below V", must be signaled to the crew during flight.

e) Dispatch with known failure conditions. If the airplane is to be dispatched in a known system failure condition that affects structural performance, or affects the reliability of the remaining system to maintain structural performance, then the provisions of § 25.302 must be met for the dispatched condition and for subsequent failures. Flight limitations and expected operational limitations may be taken into account in establishing Q_j as the combined probability of being in the dispatched failure condition and the subsequent failure condition for the safety margins in Figures 2 and 3. These limitations must be such that the probability of being in this combined failure state and then subsequently encountering limit load conditions is extremely improbable. No reduction in these safety margins is allowed if the subsequent system failure rate is greater than $1E-3$ per hour.

4. By amending § 25.305 by revising paragraph (f) to read as follows:

§ 25.305 Strength and deformation.

* * * * *

(f) Unless shown to be extremely improbable, the airplane must be designed to withstand any forced structural vibration resulting from any failure, malfunction or adverse condition in the flight control system. These loads must be treated in accordance with the requirements of § 25.302.

5. By amending § 25.629 by revising paragraphs (a), (c), and (d)(2) and by adding a new paragraph (b)(3) to read as follows:

§ 25.629 Aeroelastic stability requirements.

(a) General. The aeroelastic stability evaluations required under this section include flutter, divergence, control reversal and any undue loss of stability and control as a result of structural deformation. The aeroelastic evaluation must include whirl modes associated with any propeller or rotating device that contributes significant dynamic forces. Compliance with this section must be shown by analysis, tests, or some combination thereof as found necessary by the Administrator.

(b) * * * *

(3) For failure conditions in those systems covered by § 25.302, the margins defined in Appendix K of this part apply.

(c) Balance weights. If balance weights are used, their effectiveness and strength, including supporting structure, must be substantiated.

(d) * * * *

(2) Any single failure in any flutter damper or flutter control system.

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